

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER

425-774P

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/530184

INTERNATIONAL APPLICATION NO.

PCT/JP99/04876

INTERNATIONAL FILING DATE

September 8, 1999

PRIORITY DATE CLAIMED

September 14, 1998

TITLE OF INVENTION

GAS GENERATING COMPOSITION

APPLICANT(S) FOR DO/EO/US

YAMATO, Yo

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19<sup>th</sup> month from the earliest claimed priority date
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
- a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
- b. ☒ has been transmitted by the International Bureau.
- c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(3)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).
- a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
- b. ☐ have been transmitted by the International Bureau.
- c. ☒ have not been made; however, the time limit for making such amendments has NOT expired.
- d. ☒ have not been made and will not be made.
8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.-1449 and International Search Report (PCT/ISA/210)
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
- ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
- 1.) Zero (0) sheets of Formal Drawings

17. ☒ The following fees are submitted:

**BASIC INTERNATIONAL FEE (37 CFR 1.492(a)(1)-(5):**

Neither international preliminary examination fee (37 CFR 1.482)  
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO  
and International Search Report not prepared by the EPO or JPO. .... **\$970.00**

International preliminary examination fee (37 CFR 1.482) not paid to  
USPTO but International Search Report prepared by the EPO or JPO. .... **\$840.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO  
but international search fee (37 CFR 1.445(a)(2)) paid to USPTO. .... **\$690.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO  
but all claims did not satisfy provisions of PCT Article 33(1)-(4). .... **\$670.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO  
and all claims satisfied provisions of PCT Article 33(1)-(4). .... **\$96.00**

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

Surcharge of **\$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(e)).

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total Claims	9 - 20 =	0	X \$18.00

Independent Claims	1 - 3 =	0	X \$78.00
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MULTIPLE DEPENDENT CLAIM(S) (if applicable)	None	+ \$260.00
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**TOTAL OF ABOVE CALCULATIONS = \$ 840.00**

Reduction of ½ for filing by small entity, if applicable. Verified Small Entity statement  
must also be filed (Note 37 CFR 1.9, 1.27, 1.28). **\$ 0**

**SUBTOTAL = \$ 0**

Processing fee of **\$130.00** for furnishing the English translation later than ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(f)). **\$ 0**

**TOTAL NATIONAL FEE = \$ 840.00**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **\$40.00** per property + **\$ 40.00**

**TOTAL FEES ENCLOSED = \$ 880.00**

Amount to be: refunded	\$
charged	\$

a. ☒ A check in the amount of **\$ 880.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account. No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
overpayment to Deposit Account No. **02-2448**.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

Send all correspondence to:

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SIGNATURE 

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REGISTRATION NUMBER

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: YAMATO, Yo  
Int'l. Appl. No.: PCT/JP99/04876  
Appl. No.: New Group:  
Filed: April 26, 2000 Examiner:  
For: GAS GENERATING COMPOSITION

PRELIMINARY AMENDMENT

**BOX PATENT APPLICATION**

Assistant Commissioner for Patents  
Washington, DC 20231

April 26, 2000

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/JP99/04876 which has an International filing date of September 8, 1999, which designated the United States of America.--

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

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RCS/cqc  
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(Rev. 04/19/2000)

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426 Rec'd PCI/PTO 26 APR 2000

DESCRIPTION

GAS GENERATING COMPOSITION

TECHNICAL FIELD TO WHICH THE INVENTION BELONGS

This invention relates to a gas generating composition which is suitable as a gas generating agent for an air bag system installed in automobiles, airplanes and the like for protecting human bodies.

PRIOR ART

Various requirements have been put forth on a gas generating agent for an air bag inflator. It is one of the requirements that a combustion residue after combustion should be reduced. When a combustion residue generated by combustion of a gas generating agent is released outside an inflator, there occur a first problem that a combustion residue having a great heat capacity is contacted with an air bag to hole therethrough, a second problem that a large amount of a floating misty residue might cause an asthmatic passenger to have a fit, and a third problem that a large amount of a floating misty residue might prevent a passengers' view to make accidents more serious. In order to prevent occurrence of such problems, it is required that a combustion residue should be cooled and filtered through a coolant/filter to remain in an

inflator. To this end, however, it is necessary to install a large coolant/filter inside an inflator. In addition, when a large amount of a combustion residue is generated, a coolant/filter is likely to damage, and its function declines in a short time. Accordingly, for decreasing an amount of a combustion residue released outside an inflator, a method of developing a gas generating agent in which an amount of a combustion residue generated is substantially small is most desirable.

Further, it is currently required to more downsize an air bag inflator and to reduce its weight more. However, an existing gas generating agent in which an amount of a combustion residue is large requires an additional component such as a large filter for filtration of a combustion residue or the like. It is therefore difficult to more downsize an inflator itself. From this standpoint as well, a gas generating agent in which an amount of a combustion residue is decreased has been required.

#### DISCLOSURE OF THE INVENTION

This invention aims to provide a gas generating composition having excellent combustion characteristics as a gas generating agent in which an amount of a combustion residue generated is decreased.

This invention further aims to provide an inflator system using the above gas generating composition.

This invention provides a gas generating composition comprising a fuel made of nitroguanidine, guanidine nitrate or a mixture thereof and an oxidizing agent.

This invention further provides an inflator system using the gas generating composition.

The gas generating agent of this invention is, compared with gas generating agents disclosed so far, by far excellent because of the small amount of the combustion residue, whereby a gas generator can be downsized more to be applied to an air bag system.

#### PREFERRED EMBODIMENT OR THE INVENTION

The fuel used in this invention is made of nitroguanidine, guanidine nitrate or a mixture thereof. A mixing ratio of nitroguanidine and guanidine nitrate is not particularly limited.

The content of the fuel in the gas generating composition varies with types of an oxidizing agent, a chlorine neutralizer and a binder and an oxygen balance. It is preferably between 35 and 80% by weight, more preferably between 45 and 70% by weight.

Examples of the oxidizing agent used in this invention

can include a perchloric acid salt, a nitric acid salt and a mixture thereof.

Examples of the perchloric acid salt and the nitric acid salt can include perchloric acid salts and nitric acid salts containing a cation selected from the group consisting of ammonium, alkali metals and alkaline earth metals. Examples of such perchloric acid salts and nitric acid salts can include ammonium perchlorate, sodium perchlorate, potassium perchlorate, magnesium perchlorate, barium perchlorate, ammonium nitrate, sodium nitrate, potassium nitrate, magnesium nitrate, strontium nitrate and the like. Of these, sodium perchlorate, magnesium perchlorate, sodium nitrate and mixtures thereof are especially preferable because the amount of the residue generated after combustion is small in particular.

As the oxidizing agent, the above-described compounds may be combined in any manner. However, the content of the oxidizing agent in the gas generating agent is preferably between 65 and 20% by weight, more preferably between 50 and 25% by weight.

When ammonium perchlorate is incorporated as the oxidizing agent, a chlorine neutralizer is incorporated for neutralizing a chlorine-type gas such as hydrogen chloride, a chlorine gas or the like for stabilization.



As the chlorine neutralizer, a compound containing a cation selected from the group consisting of alkali metals and alkaline earth metals can be proposed. As the compound containing such a cation, at least one can be proposed which is selected from the group consisting of carbonic acid salts such as sodium carbonate, potassium carbonate, magnesium carbonate, calcium carbonate, strontium carbonate and the like; nitric acid salts such as sodium nitrate, potassium nitrate, magnesium nitrate, calcium nitrate, strontium nitrate and the like; silicic acid salts such as sodium silicate, potassium silicate, magnesium silicate, calcium silicate, strontium silicate and the like; oxalic acid salts such as sodium oxalate, potassium oxalate, magnesium oxalate, calcium oxalate, strontium oxalate and the like; oxides such as magnesium oxide, calcium oxide, strontium oxide and the like; peroxides such as magnesium peroxide, calcium peroxide, strontium peroxide and the like; cellulose salts such as sodium carboxymethyl cellulose and the like; salts of tetrazole and triazole such as sodium salt, potassium salt, magnesium salt, calcium salt, strontium salt and the like of 5-aminotetrazole; salts of bitetrazole such as sodium salt, potassium salt, magnesium salt, calcium salt, strontium salt and the like of bitetrazole; and so forth.

The content of the chlorine neutralizer in the gas

generating composition is preferably between 5 and 40% by weight, more preferably between 10 and 30% by weight.

Further, the gas generating composition can contain, as required, a binder, a combustion catalyst and the like.

Examples of the binder can include inorganic binders such as silica, alumina, molybdenum disulfide, Japanese acid clay, talc, bentonite, diatomaceous earth, kaolin and the like; and organic binders such as metal salts of carboxymethyl cellulose and the like, starch, microcrystalline cellulose, guar gum, polyacrylamide, polyvinyl alcohol, stearic acid metal salts, oligomers and the like.

Examples of the combustion catalyst can include  $\text{CuO}$ ,  $\text{Cu}_2\text{O}$ ,  $\text{Co}_2\text{O}_3$ ,  $\text{CoO}$ ,  $\text{Co}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{FeO}$ ,  $\text{Fe}_3\text{O}_4$ ,  $\text{MnO}_2$ ,  $\text{Mn}_2\text{O}_3$ ,  $\text{Mn}_3\text{O}_4$ ,  $\text{NiO}$ ,  $\text{ZnO}$ ,  $\text{MoO}_3$ ,  $\text{CoMoO}_4$ ,  $\text{Bi}_2\text{MoO}_6$ ,  $\text{Bi}_2\text{O}_3$  and the like.

It is advisable that the total amount of the additives in the gas generating composition is between 0.1 and 20% by weight.

In the gas generating composition of this invention, the gas composition after combustion can be changed by changing an oxygen balance. For example, it is possible to decrease CO (increase NOx) by changing the oxygen balance to the plus side. Conversely, it is possible to decrease NOx (increase CO) by changing the oxygen balance to the minus side. Accordingly, it is advisable to adjust the oxygen balance in

consideration of the safety to human bodies.

The gas generating composition of this invention can be produced by a dry method of mixing a fuel, an oxidizing agent, a chlorine neutralizer, additives and the like in a powdery state or a wet method of mixing the same in the presence of water or an organic solvent.

Further, the gas generating composition of this invention can also be molded into a desired form. For example, it can be compression-molded into a pellet using a pelletizer or into a disk using a disk press machine, a pellet or a disk can be pulverized or granulated using a granulator to form granules or it can be extrusion-molded using an extruder (extrusion-molding machine) to form an extruded pellet (non-perforated, single-perforated or porous shape).

These molding methods can be selected, as required, according to properties and the like which are to be imparted to a molded article of the gas generating composition. For example, in the compression-molding method, inherently, a binder is not required or may be used in a small amount in the molding, so that this is suitable as a method of molding the gas generating composition of this invention. Further, when the extrusion-molding method is employed, it is easier to form an article of a thin web than the compression-molding method. Accordingly, a molded article of a thin web can be obtained

with a composition having a low burning rate. Further, the extrusion-molding method is suited for mass-production because it is conducted for a relatively short period of time. Still further, in case of a composition having a high burning rate, a size of a molded article can be increased, making it possible to more improve a production efficiency. Besides, when the extrusion-molding method is employed, a molded article of a non-perforated, single-perforated or porous complicated shape can be produced, so that various combustion characteristics can be imparted.

In the gas generating composition of this invention, the amount of the combustion residue per 1 mol of a gas generated is preferably 12 g/mol or less, especially preferably 10 g/mol or less. This amount of the combustion residue is a total amount of components generated as a solid component and a liquid component in an inflator output temperature which is calculated according to the formulation of the gas generating composition.

The gas generating composition of this invention can be used in any device requiring a gas generating ability of a gun propellant or a rocket propellant. It is especially suited for an inflator system of an air bag installed in automobiles, airplanes and the like for protecting human bodies.

The inflator system of this invention uses the

above-described gas generating composition, and they may be applied to a pyrotechnic inflator system, in which all the gas is supplied from a gas generating agent, or a hybrid inflator system, in which gas is supplied from both a compressed gas such as argon and a gas generating agent.

A gas generating method of this invention is a method in which the above-described gas generating composition is burned as a fuel in a gas generator, and it can be applied to various fields utilizing the gas generated by this burning. In the gas generating method of this invention, the gas generating composition is used as a fuel, making it possible to decrease the amount of the combustion residue and improve the gas output.

#### EXAMPLES

This invention is illustrated specifically with reference to the following Examples and Comparative Examples. However, this invention is not limited to these Examples only. Examples 1 to 14 and Comparative Examples 1 to 3

Gas generating compositions having formulations shown in Table 1 were obtained. An amount of a combustion residue generated when each of these gas generating compositions generated 1 mol of a gas was measured. The amount of the combustion residue of the gas generating agent containing

nitroguanidine, guanidine nitrate or a mixture thereof was shown as Examples, and an amount of a combustion residue measured by calculation in gas generating agents disclosed in JP-A 9-501137, JP-A 4-265292 and JP-A 6-239683 was shown as Comparative Examples 1 to 3.

The amount of the combustion residue in the gas generating compositions of this invention was much smaller than that in many gas generating agents disclosed to date.

Examples 15 to 28

Gas generating compositions having formulations shown in Table 2 were obtained. An amount of a gas generated from these gas generating compositions was measured.

It was identified that in the gas generating compositions of this invention, the amount of the gas generated was sufficient for an air bag.

Examples 29 to 41

Gas generating compositions having formulations shown in Table 3 were obtained. A burning rate of these gas generating compositions and a density of strands of the gas generating agents were measured. The burning rate was measured at a pressure of 70 kgf/cm<sup>2</sup>.

It was identified that in the gas generating compositions of this invention, the burning rate was sufficient for an air bag.

Examples 42 to 52

Gas generating compositions having formulations shown in Table 4 were obtained. These compositions were subjected to a test for a thermal stability. In the test for the thermal stability, the composition placed in an aluminum container was allowed to stand in a constant-temperature bath of 105°C for 400 hours, a weight loss ratio was found from the change in weight of the composition before and after the test, and the thermal stability was evaluated.

The weight loss of the compositions of this invention was slight, and no change in the appearance was observed.

Examples 53 to 63

Gas generating compositions having formulations shown in Table 5 were obtained. These compositions were subjected to a friction sensitivity test and a drop hammer test. The test for the friction sensitivity was conducted according to Standard ES-22 of the Industrial Explosives Society, Japan using a BAM-type friction sensitivity tester. The test for the drop hammer sensitivity was conducted according to Standard ES-21 (1) of the Industrial Explosives Society, Japan using an iron hammer of 5 kg.

It was identified that both of the friction sensitivity and the drop hammer sensitivity of the compositions in this invention were low and the safety was high.

Table 1

	Formulation	wt. %	Amount of combustion residue based on amount of gas generated (g/mol)
Example 1	nitroguanidine/ $\text{NaNO}_3$	(60.5/39.5)	8.2
Example 2	nitroguanidine/ $\text{NaClO}_4$	(63/37)	5.4
Example 3	nitroguanidine/ $\text{Mg}(\text{ClO}_3)_2$	(65.1/34.9)	2.0
Example 4	guanidine nitrate/ $\text{NaNO}_3$	(64.2/35.8)	7.1
Example 5	guanidine nitrate/ $\text{NaClO}_4$	(66.6/33.4)	4.8
Example 6	guanidine nitrate/ $\text{Mg}(\text{ClO}_3)_2$	(68.6/31.4)	1.6
Example 7	nitroguanidine/guanidine nitrate/ $\text{NaClO}_4$	(31.5/33.3/35.2)	5.1
Example 8	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{NaNO}_3$	(56.2/25.4/18.4)	3.6
Example 9	guanidine nitrate/ $\text{NH}_4\text{ClO}_4$ / $\text{NaNO}_3$	(60.1/23.1/16.8)	3.2
Example 10	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{Na}_2\text{CO}_3$	(56/25/19)	5.7
Example 11	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{Na}_2\text{SiO}_3$	(55/25/20)	7.6
Example 12	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{Na}_2\text{C}_2\text{O}_4$	(54/25/21)	5.2
Example 13	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{CaO}_2$	(50/25/25)	7.2
Example 14	nitroguanidine/ $\text{NH}_4\text{ClO}_4$ / $\text{NaNO}_3$ /CMC-Na	(47.1/26.6/19.3/7)	3.8
Comparative Example 1	5-aminotetrazole/ $\text{CuO}$	(23.4/76.6)	44.5
Comparative Example 2	5-aminotetrazole/ $\text{Sr}(\text{NO}_3)_2$ / $\text{SiO}_2$	(33.1/58.9/8)	16.5
Comparative Example 3	carbohydrazide/ $\text{KClO}_4$ / $\text{CaO}$	(39/61/10)	14.2



Table 2

	Formulation	wt.%	Amount of gas generated (mol/100 g)
Example 15	nitroguanidine/ $\text{NaNO}_3$	(60.5/39.5)	2.9
Example 16	nitroguanidine/ $\text{NaClO}_4$	(63/37)	3.3
Example 17	nitroguanidine/ $\text{Mg}(\text{ClO}_4)_2$	(65.1/34.9)	3.3
Example 18	guanidine nitrate/ $\text{NaNO}_3$	(64.2/35.8)	3.2
Example 19	guanidine nitrate/ $\text{NaClO}_4$	(66.6/33.4)	3.3
Example 20	guanidine nitrate/ $\text{Mg}(\text{ClO}_4)_2$	(68.6/31.4)	3.5
Example 21	nitroguanidine/guanidine nitrate/ $\text{NaClO}_4$	(31.5/33.3/35.2)	3.3
Example 22	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(56.2/25.4/18.4)	3.5
Example 23	guanidine nitrate/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(60.1/23.1/16.8)	3.6
Example 24	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{Na}_2\text{CO}_3$	(56/25/19)	3.5
Example 25	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{Na}_2\text{SiO}_3$	(55/25/20)	3.2
Example 26	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{Na}_2\text{C}_2\text{O}_4$	(54/25/21)	3.4
Example 27	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{CaO}_2$	(50/25/25)	3.0
Example 28	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3/\text{CMC-Na}$	(47.1/26.6/19.3/7)	3.5

Table 3

	Formulation	wt.%	Burning rate (mm/sec)	Density ( $\text{g}/\text{cm}^3$ )
Example 29	nitroguanidine/ $\text{NaNO}_3$	(60.5/39.5)	11.8	1.74
Example 30	nitroguanidine/ $\text{KNO}_3$	(56.3/43.7)	32.9	1.72
Example 31	nitroguanidine/ $\text{Sr}(\text{NO}_3)_2$	(55.1/44.9)	7.7	1.90
Example 32	nitroguanidine/ $\text{NaClO}_4$	(63/37)	19.7	1.82
Example 33	nitroguanidine/ $\text{KClO}_4$	(60.1/39.9)	27.5	1.79
Example 34	nitroguanidine/ $\text{Mg}(\text{ClO}_4)_2$	(65.1/34.9)	7.4	1.65
Example 35	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(56.2/25.4/18.4)	16.2	1.72
Example 36	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(57/20.6/22.4)	17.2	1.72
Example 37	guanidine nitrate/ $\text{KNO}_3$	(60.1/39.9)	4.2	1.62
Example 38	guanidine nitrate/ $\text{NaClO}_4$	(66.6/33.4)	6.4	1.65
Example 39	guanidine nitrate/ $\text{KClO}_4$	(63.8/36.2)	14.0	1.69
Example 40	guanidine nitrate/ $\text{Mg}(\text{ClO}_4)_2$	(68.6/31.4)	3.6	1.54
Example 41	guanidine nitrate/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(60.1/23.1/16.8)	9.4	1.63

Table 4

	Formulation	wt. %	Weight loss ratio (%)
Example 42	nitroguanidine/ $\text{NaNO}_3$	(60.5/39.5)	-0.11
Example 43	nitroguanidine/ $\text{NaClO}_4$	(63/37)	-0.15
Example 44	nitroguanidine/ $\text{Mg}(\text{ClO}_4)_2$	(65.1/34.9)	-0.37
Example 45	nitroguanidine/ $\text{KClO}_4$	(60.1/39.9)	-0.11
Example 46	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(56.2/25.4/18.4)	-0.11
Example 47	guanidine nitrate/ $\text{NaClO}_4$	(66.6/33.4)	-0.06
Example 48	guanidine nitrate/ $\text{KClO}_4$	(63.8/36.2)	-0.07
Example 49	guanidine nitrate/ $\text{KNO}_3$	(60.1/39.9)	-0.07
Example 50	guanidine nitrate/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(60.1/23.1/16.8)	-0.06
Example 51	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{Na}_2\text{CO}_3$	(56/25/19)	-0.09
Example 52	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3/\text{CMC-Na}$	(47.1/26.6/19.3/7)	-0.09

Table 5

	Formulation	wt. %	Friction sensitivity (kgf)	Drop hammer sensitivity (cm)
Example 53	nitroguanidine/ $\text{NaNO}_3$	(60.5/39.5)	>36	90 – 100
Example 54	nitroguanidine/ $\text{NaClO}_4$	(63/37)	>36	40 – 50
Example 55	nitroguanidine/ $\text{Mg}(\text{ClO}_4)_2$	(65.1/34.9)	>36	>100
Example 56	nitroguanidine/ $\text{KClO}_4$	(60.1/39.9)	>36	30 – 40
Example 57	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(56.2/25.4/18.4)	>36	80 – 90
Example 58	guanidine nitrate/ $\text{NaClO}_4$	(66.6/33.4)	>36	>100
Example 59	guanidine nitrate/ $\text{KClO}_4$	(63.8/36.2)	>36	70 – 80
Example 60	guanidine nitrate/ $\text{KNO}_3$	(60.1/39.9)	>36	90 – 100
Example 61	guanidine nitrate/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3$	(60.1/23.1/16.8)	>36	80 – 90
Example 62	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{Na}_2\text{CO}_3$	(56/25/19)	>36	40 – 50
Example 63	nitroguanidine/ $\text{NH}_4\text{ClO}_4/\text{NaNO}_3/\text{CMC-Na}$	(47.1/26.6/19.3/7)	>36	80 – 90

# CLAIMS

1. A gas generating composition comprising a fuel made of nitroguanidine, guanidine nitrate or a mixture thereof and an oxidizing agent.

2. The gas generating composition according to claim 1, wherein the oxidizing agent is a perchloric acid salt, a nitric acid salt or a mixture thereof, and the perchloric acid salt and the nitric acid salt are salts containing a cation selected from the group consisting of ammonium, alkali metals and alkaline earth metals.

3. The gas generating composition according to claim 1, wherein the oxidizing agent is ammonium perchlorate, and further contains a chlorine neutralizer.

4. The gas generating composition according to claim 3, wherein the chlorine neutralizer is a compound containing a cation selected from the group consisting of alkali metals and alkaline earth metals.

5. The gas generating composition according to claim 1, wherein the content of the fuel is between 35 and 80% by weight, and the content of the oxidizing agent is between 65 and 20% by weight.

6. The gas generating composition according to claim 1, which further comprises a binder or a combustion catalyst as an additive.

7.The gas generating composition according to claim 1, wherein an amount of a combustion residue based on an amount of a gas generated is 12 g/mol or less.

8.An inflator system using the gas generating composition according to claim 1.

9.A gas generating method using a gas generated by burning a fuel, in which the gas generating composition according to claim 1 is used as a fuel to decrease an amount of a combustion residue and improve a gas output.

# ABSTRACT

A gas generating composition is obtained in which an amount of a combustion residue based on a unit amount of a gas generated is reduced.

A gas generating composition comprising nitroguanidine, guanidine nitrate or a mixture thereof as a fuel and further an oxidizing agent. The oxidizing agent is a perchloric acid salt, a nitric acid salt or a mixture thereof, and when the oxidizing agent is ammonium perchlorate, a chlorine neutralizer is further incorporated.

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ATTORNEY DOCKET NO.  
425-774P

## FOR PATENT AND DESIGN APPLICATIONS

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title: **GAS GENERATING COMPOSITION**

Fill in Appropriate  
Information -  
For Use Without  
Specification  
Attached:

the specification of which is attached hereto. If not attached hereto,  
the specification was filed on \_\_\_\_\_ as  
United States Application Number \_\_\_\_\_; and /or  
the specification was filed on September 8, 1999 as PCT  
International Application Number PCT/JP99/04876; and was  
amended under PCT Article 19 on \_\_\_\_\_ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Insert Priority  
Information:  
(if appropriate)

## Prior Foreign Application(s)

(Number)	(Country)	(Month/Day/Year Filed)
10-259566	Japan	Sept. 14, 1998
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

## Priority Claimed

Yes	No
<input checked="" type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

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(if any)

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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Insert Prior U.S.  
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(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)
_____	_____	_____
_____	_____	_____

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First or Sole Inventor: Insert Name of Inventor Insert Date This Document is Signed	GIVEN NAME Yo	FAMILY NAME YAMATO	INVENTOR'S SIGNATURE <i>Yo Yamato</i>	DATE* March 29, 2000
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Full Name of Third Inventor, if any: see above	GIVEN NAME	FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
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Full Name of Fifth Inventor, if any: see above	GIVEN NAME	FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
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